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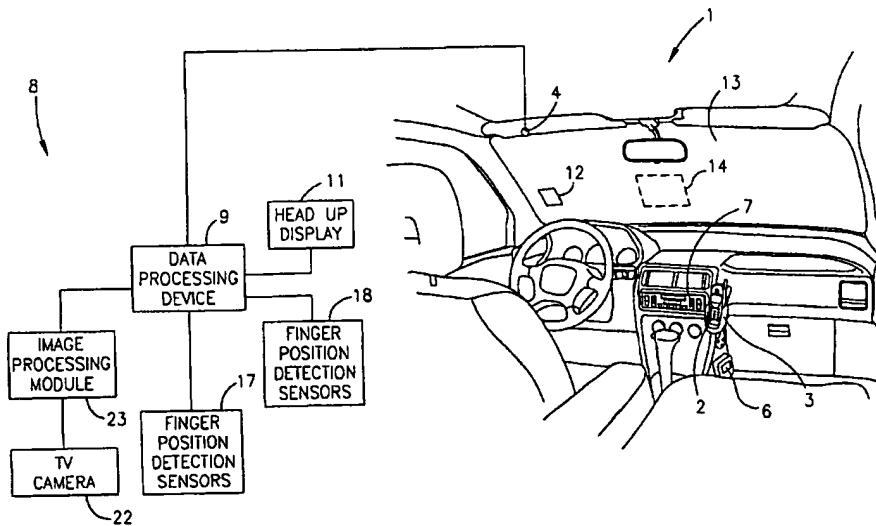
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(54) Title: SAFETY DEVICES FOR USE IN MOTOR VEHICLES



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(57) Abstract: The present invention is directed toward head-up display based safety devices for use in motor vehicles. The first aspect of the present invention is directed towards facilitating accurate driver operation of a driver operable device deployable in a motor vehicle without the need for a driver to turn his eyes downwards toward its control panel. This can be achieved by either providing an icon representative of the position of a driver's fingertip positioned for operating the driver operable device for superimposition on a head-up display image of the layout of its control panel, or employing a speech recognition module to issue output control signals in accordance with spoken commands. The second aspect of the present invention is directed toward projecting a head-up display image of a driver's rear field of vision including wireframe images of objects located therein.

## SAFETY DEVICES FOR USE IN MOTOR VEHICLES

### Field of the Invention

The invention in the field of safety devices for use in motor vehicles in general, and head-up display based safety devices for use in motor vehicles in particular.

### Background of the Invention

Considerable efforts have been invested over the years to facilitate safe operation of driver operable devices during driving of motor vehicles.

Exemplary prior art references include:

US Patent 4,827,520 illustrates and describes a voice actuated control system for use in a motor vehicle. The control system includes a voice processing circuit and memory for storing data representing command words employed to perform control functions for vehicle accessories and for detecting spoken command words and providing data corresponding thereto. The control system also includes a display and control panel to selectively provide visual prompts to the operator and a manual control.

US Patent 5,555,502 illustrates and describes a control system for assisting the driver of a motor vehicle in selectively adjusting the various electronics components present within his vehicle. The control system includes a control panel containing a plurality of selection keys for selecting an adjustable feature from any component in his vehicle, a tactile control for adjusting the selected feature, and an electronics display for displaying information relevant to his operation of the various components. The display may be a head-up display for projecting a head-up display image onto the windshield.

US Patent 5,784,036 illustrates and describes a head-up display arrangement having touch sensors on control switches mounted inside a vehicle whereby, on detection of a user contact on a control switch, the image of the control switch which the driver contacted is displayed in such a manner as to

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distinguish it from the images of its neighbouring control switches which he did not contact, thereby enabling him to distinguish which control switch he contacted without having to turn his eyes downwards from the forward direction of his moving vehicle.

5 Japanese Patent Laid-open Publication No. 07-307775 (US Patent 6,091,376) illustrates and describes the deployment of a touch panel on a front windshield duplicating the actual control panel of a mobile telephone handset to negate the need that a driver has to turn his eyes downwards away from the forward direction of his moving motor vehicle towards the control switches in  
10 order to locate the actual control switch that he wishes to depress.

### **Summary of the Invention**

The present invention is directed toward head-up display based safety devices for use in motor vehicles. The first aspect of the present invention is directed towards facilitating accurate driver operation of a driver operable device  
15 deployable in a motor vehicle without the need for a driver to turn his eyes downwards toward its control panel, thereby impeding his control over his motor vehicle. This can be achieved by either providing an icon representative of the position of a driver's fingertip positioned for operating a driver operable device for superimposition on a head-up display image of the layout of its control panels,  
20 or by employing a speech recognition module to issue output control signals in accordance with spoken commands, thereby simplifying their operation in comparison to their conventional operation. The second aspect of the present invention is directed toward projecting a head-up display image of a driver's rear field of vision including wireframe images of objects located therein.

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### **Brief Description of the Drawings**

In order to understand the present invention and to see how it can be carried out in practice, preferred embodiments will now be described, by way of

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non-limiting examples only, with reference to the accompanying drawings, in which similar parts are likewise numbered, and in which:

Fig. 1 is a pictorial representation of the interior of a motor vehicle fitted with a mobile telephone and a radio cassette player, and a schematic diagram of a safety device in accordance with one embodiment of the present invention for use during manual operation of the mobile telephone and the radio cassette player;

5 Fig. 2 is a block diagram of the safety device of Figure 1;

Figs. 3A and 3B are schematic views depicting the operation of the safety device of Figure 1 during manual operation of the mobile telephone;

10 Figs. 4A and 4B are schematic views depicting the operation of the safety device of Figure 1 during manual operation of the radio of the radio cassette player;

Fig. 5 is a schematic view depicting a head-up display image of a driver's rear field of vision including wireframe images of objects located therein;

15 Fig. 6 is a pictorial representation of the interior of a motor vehicle fitted with a mobile telephone and an in-car audio player, and a schematic diagram of a safety device in accordance with another embodiment of the present invention for use during remote operation of the mobile telephone and the in-car audio center;

20 Fig. 7 is a schematic view of a manually operated icon positioning apparatus of the safety device of Figure 6 operative from the motor vehicle's steering wheel;

Figs. 8A and 8B are schematic views depicting the operation of the safety device of Figure 6 during remote operation of the mobile telephone;

25 Fig. 9 is a schematic view depicting a virtual icon positioning apparatus of the safety device of Figure 6 operative from the motor vehicle's steering wheel;

Fig. 10 is a schematic view depicting a portion of the virtual component control panel of the virtual icon positioning apparatus for remote operation of the radio of the in-car audio center;

Fig. 11 is a schematic view depicting a portion of the virtual component control panel of the virtual icon positioning apparatus for remote operation of the cassette player of the in-car audio center;

5 Fig. 12 is a schematic view depicting a portion of the virtual component control panel of the virtual icon positioning apparatus for remote operation of the CD player of the in-car audio center;

Figs. 13A, 13B and 13C are schematic views depicting the operation of the safety device during remote operation of the radio of the in-car audio center; and

10 Figs. 14A and 14B are schematic views depicting the operation of the safety device during voice activation of the mobile telephone.

#### Detailed Description of the Drawings

Figure 1 shows the interior of a motor vehicle 1 fitted with a mobile telephone 2 (constituting a driver operable device having a manually operable control panel, and a display window) residing in a cradle 3, and connected to an external microphone 4, and an external loudspeaker 6. The motor vehicle 1 is also fitted with a radio cassette player 7 (also constituting a driver operable device). The operation of both the mobile telephone 2 and the radio cassette player 7 is facilitated by a safety device 8 having a data processing device 9 for controlling a head-up display 11 for projecting an image on a combiner 12 mounted on the motor vehicle's front windshield 13 for displaying a head-up display image 14 which can be readily viewed by a driver driving the motor vehicle 1 without having to divert his gaze from his front field of vision. The brightness of the head-up display image 14 is adjusted in accordance with the 25 prevailing light conditions as sensed by a photo cell 16 (see Figure 2).

The data processing device 9 is connected to finger position detection sensors 17 (constituting icon positioning apparatus) deployed on the cradle 3 for continuously tracking the position of the fingertip of typically a driver's forefinger positioned to operate the mobile telephone 2 for automatically

displaying an icon representative of his fingertip on a head-up display image of a near exact replica of the mobile telephone's actual control panel on detection of his forefinger approaching same. Similarly, the data processing device 9 is connected to finger position detection sensors 18 deployed around the periphery 5 of the radio cassette player 7 for automatically displaying an icon representative of his fingertip on a head-up display image of a near exact replica of the radio cassette's actual control panel on detection of his forefinger approaching same. The layout of the control panels of the various driver operable devices can be downloaded, for example, via an infrared port 19 from a CD, the Internet, and the 10 like for storage in a memory 21 (see Figure 2). Typical finger position detector sensors include *inter alia* electro-optical sensors, ultra sound sensors, and the like.

Rather than provisioning an icon positioning apparatus adjacent to each driver operable device whose manual operation is to be facilitated by way of the safety device 8, a single icon positioning apparatus can be employed for same 15 purpose of continuously tracking a driver's fingertip for automatically displaying an icon representative thereof on a head-up display image of near exact replicas of their corresponding actual control panels on detection of his forefinger approaching same. Such an icon positioning apparatus could be implemented in the form of a TV camera deployed on the inside of the motor vehicle's roof and 20 downwardly directed towards the motor vehicle's driver console.

In the case of the mobile telephone 2, since on the one hand, the position of the driver's fingertip is known, and, on the other hand, the depression of one of its pushbuttons can be detected by virtue of it issuing a beep or similar audible indication, the data processing device 9 can also determine which pushbuttons 25 have been depressed by the driver for displaying at least the digits of a telephone number entered on the mobile telephone's control panel for display in the head-up display image 14.

The safety device 8 can also include a rear facing TV camera 22 (constituting an image acquisition apparatus) deployed for acquisitioning an 30 image of the driver's rear field of vision for processing by an image processing

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module 23 for rendering wireframe images of objects located in the image of the driver's rear field of vision for inclusion in a head-up display image of the driver's rear field of vision. The image processing module 23 typically employs conventional image processing techniques for edge detection. The head-up display 11 preferably automatically displays the head-up display image of the driver's rear field of vision when the motor vehicle 1 is put into reverse gear.

5 The operation of the safety device 8 is now described:

In the case that a driver wishes to safely make a telephone call while driving, he proceeds to start dialing the desired telephone number whereupon the 10 position of his forefinger relative to the mobile telephone's control panel (see Figure 3A) is continuously tracked on the head-up display image (see Figure 3B) together with the dialed telephone number such that the driver can safely and accurately operate the mobile telephone without having to divert his gaze theretoward. The safety device operates in a similar fashion when the driver 15 manually operates the radio or the cassette player of the radio cassette player except that in this case the head up display image does not display the information displayed in its display window (see Figures 4A and 4B). On putting his motor vehicle into reverse gear, the data processing device displays a head-up display image of the driver's rear field of vision including wireframes of any 20 objects located therein, for example, a sidewalk, a lamppost, and another parked motor vehicle such that the driver can safely reverse his motor vehicle (see Figure 5).

Figure 6 shows a safety device 24 similar to the safety device 8 except that it is suitable for remote operation of driver operable devices having data input 25 capabilities, for example, a mobile telephone 26, an in-car audio center 27 combining a radio, a cassette player, and a CD player, and the like. Remote operation of a driver operable device can be achieved by driver operation of a virtual control panel shown on the head-up display image 14 either from a manually operated icon positioning apparatus 28 or a virtual icon positioning 30 apparatus 29 both preferably operative from the hub 31 of the motor vehicle's

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steering wheel 32. Alternatively, remote operation of a driver operable device can be voice activated by using a speech recognition module 33 programmed to recognize a set of predetermined spoken commands. In the case that a driver operable device also has data output capabilities, the safety device 24 can also  
5 display the same information displayed in the device's display window in the head-up display image 14. Also, in the case that the mobile telephone 26 does not have a data output capability, at least a dialed telephone number can be displayed on the head-up display image 14 in the similar manner as described hereinabove with reference to the safety device 8 since remote actuation of a  
10 pushbutton also causes the issue of a beep or similar audible indication. Optionally, the safety device 24 can include the back sensing capability enabled by the TV camera 22 and the image processing module 23.

Figure 7 shows that the manually operated icon positioning apparatus 28 can be implemented as a touchpad 34 similar to that deployed on laptop  
15 computers, PDAs, and the like, for operating a virtual control panel displayed on the head-up display image 14. The touchpad 34 is sensitive to both a driver tracing his figure on its surface for effecting displacement of the icon representative of his finger, and also his tapping his finger on its surface being the equivalent of his depressing a left touchpad pushbutton. Alternatively the  
20 manually operated icon positioning apparatus 28 can constituted by a trackball, and left and right mouse buttons. The manually operated icon positioning apparatus 28 is employed for operating a Windows-like desktop 38 having a lower selection bar 39 having a plurality of driver selectable fields 41 for selecting a virtual component control panel 42 each dedicated for the operation of  
25 either the mobile telephone 26, or one of the components of the in-car audio center 27. The safety device 24 displays an icon representative of the fingertip of typically a driver's forefinger superimposed on the head-up display image 14 of the selection bar 41 and/or the virtual component control panel 42 in a similar manner to the safety device 8 (see Figures 8A and 8B).

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Figure 9 shows the virtual icon positioning apparatus 29 operative from the steering wheel's hub 31 by finger contact thereon detectable by a TV camera deployed on the inside of the motor vehicle's roof and downwardly directed towards the motor vehicle's driver console. The virtual icon positioning apparatus 29 is effectively divided into two portions: a virtual selection panel 43 comparable to the virtual selection bar 41, and a virtual component control panel 44 comparable to the virtual component control panel 42. The virtual selection panel 43 can include a virtual selection pushbutton 46A for selecting remote operation of the mobile telephone 26, and virtual selection pushbuttons 46B, 46C 5 and 46D for selecting remote operation of the radio, the cassette player and the CD player of the in-car audio center 27, respectively. The virtual component control panel 44 is employed for the actual driver remote operation, and is preferably has the same layout for each of the components of the in-car audio center 27. Furthermore, the leftmost and rightmost virtual pushbuttons 47A and 10 47E preferably have the same function for all the components of the in-car audio center 27, namely, an ON/OFF pushbutton and a VOLUME control, respectively. During remote operation of the radio, the three middle virtual pushbuttons 47B, 47C and 47D operate as PRESET controls for tuning the radio in a similar manner to its actual preset pushbuttons (see Figure 10). During remote operation 15 of the cassette player, the three middle virtual pushbuttons 47B, 47C and 47D operate as REWIND, PLAY and FORWARD PRESET controls (see Figure 11). During remote operation of the CD player, the three middle virtual pushbuttons 47B, 47C and 47D operate to play the corresponding discs as stacked in the CD player (see Figure 12). The operation of the safety device 24 having the virtual 20 icon positioning apparatus 29 is similar to that having the manually operated icon positioning apparatus 28 as exemplified in Figures 13A, 13B and 13C for tuning the in-car audio center's radio to its first preprogrammed radio station FM 100 on the driver contacting the virtual pushbutton 47B. As shown in Figure 13C, the in-car audio center 27 has a data output capability for displaying the same 25 information as displayed on its display window on the head-up display image 14.

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Alternatively, the driver can issue spoken commands to remotely operate the mobile telephone 26 or one of the components of the in-car audio center 27. For example, the spoken command "DIAL NUMBER" and then a recitation of digits, for example, "NINE, TWO, FOUR...." would be the equivalent of 5 consecutively depressing the pushbuttons 924 on the mobile telephone's actual control panel (see Figures 14A and 14B). Similarly, the spoken command "CD PLAYER" and "PLAY DISC TWO" could be programmed to start playing the second CD stacked in the CD player. In the case of voice activation of one of the driver operable devices, no icon representative of the position of the driver's 10 finger would be displayed but the head-up display would preferably display the same information on the device's display window on the appropriate head-up display image.

While the invention has been described with respect to a limited number 15 of embodiments, it will be appreciated that many variations, modifications, and other applications of the invention can be made within the scope of the appended claims. For example, in the same motor vehicle, one or more driver operable devices may be manually operated whilst one or more other driver operable devices may be remotely operated. Furthermore, the same driver operable device 20 may be both manually and remotely operable for back-up reasons.

**Claims**

1. A safety device for use with a driver operable device deployable in a motor vehicle, and having a manually operable control panel, and a display window, the safety device comprising:
  - (a) icon positioning apparatus for controlling the position of an icon representative of the position of a driver's fingertip positioned for operating the driver operable device on an image of its control panel; and
  - (b) a data processing device connected to a head-up display for projecting a head-up display image of the control panel with said icon superimposed thereon.
2. The safety device according to claim 1 wherein driver operation of the driver operable device is effected by manual actuation of the device's actual control panel, said head-up display image of the control panel being a substantially exact replica of the device's actual control panel, and said icon positioning apparatus substantially continuously tracking the position of the driver's fingertip relative to the device's actual control panel for display of said icon on said head-up display image.
3. The safety device according to claim 2 wherein said icon positioning apparatus includes a plurality of finger position detection sensors deployed around at least a portion of the periphery of the driver operable device.
4. The safety device according to claim 3 wherein said head-up display image is automatically displayed on detection of the driver's fingertip in the vicinity of the device's actual control panel.
5. The safety device according to claim 1 wherein the driver operable device has a data input capability for enabling its remote operation from a virtual control

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panel at least partially duplicating the functionality of the device's actual control panel, said icon positioning apparatus substantially continuously tracking the position of the driver's fingertip on said virtual control panel for display of said icon on said head-up display image of said virtual control panel.

5

6. The safety device according to claim 5 wherein said virtual control panel includes at least two virtual selection controls for determining the driver operable device, or components thereof, to be remotely operated therefrom.

10 7. The safety device according to claim 5 wherein said virtual control panel includes the same layout of virtual pushbuttons for controlling two or more different driver operable device and/or components of one of the driver operable devices.

15 8. The safety device according to any one of claims 5 to 7 wherein said icon positioning apparatus is constituted by a manually operated icon positioning apparatus deployed on the motor vehicle's steering wheel.

20 9. The safety device according to any one of claims 5 to 7 wherein said icon positioning apparatus is constituted by a virtual icon positioning apparatus operative by contact of the driver's fingertip on the motor vehicle's steering wheel.

25 10. The safety device according to any one of claims 1 to 9 wherein said data processing module displays a digit dialed on a mobile telephone on said head-up display image based on the position of the driver's fingertip at the instant of an audible indication indicative of the actuation of one of its pushbuttons.

30 11. The safety device according to any one of claims 1 to 9 wherein the driver operable device has a data output capability whereby said head-up display image

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also displays the same information as displayed in the device's display window pursuant to driver operation.

12. The safety device according to any one of claims 1 to 10 wherein the  
5 driver operable device has a I/O data capability, and the safety device further  
comprises a speech recognition module connected to said data processing device  
for providing an output control signal thereto corresponding to a spoken  
command for remote operation of the driver operable device, and said head-up  
display image displays displays the same information as displayed in the device's  
10 display window pursuant to a spoken command.

13. The safety device according to any one of claims 1 to 12, the safety device  
further comprising an image acquisition device for acquisitioning an image of the  
driver's rear field of vision, and an image processing module for rendering  
15 wireframe images of objects located in said image of the driver's rear field of  
vision and being connected to said data processing device for projecting a head-  
up display image of the driver's rear field of vision including said wireframe  
images.

20 14. The safety device according to claim 13 wherein said head-up display  
image of the driver's rear view of vision is automatically displayed when the  
motor vehicle is put into reverse gear.

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15. A safety device for use with a driver operable device deployable in a motor vehicle, the driver operable device having an I/O data capability, a manually operable control panel, and a display window, the safety device comprising:
- (a) a speech recognition module for providing an output control signal corresponding to a spoken command for remote operation of the driver operable device; and
- (b) a data processing device for remotely operating the driver operable device in accordance with an output control signal from said speech recognition module, and for projecting a head-up display image displaying the same information as displayed in the device's display window pursuant to a spoken command.
- 10
16. The safety device according to claim 15 wherein the driver operable device can be alternatively operated by manual actuation of the device's actual control panel, the safety device further comprising icon positioning apparatus for tracking the position of a driver's fingertip relative to the device's actual control panel for controlling the position of an icon representative of the position of the driver's fingertip superimposed on a head-up display image of the control panel being a substantially exact replica of the device's actual control panel.
- 15
- 20
17. The safety device according to claim 16 wherein said icon positioning apparatus includes a plurality of finger position detection sensors deployed around at least a portion of the periphery of the driver operable device.
- 25
18. The safety device according to claim 17 wherein said head-up display image is automatically displayed on detection of the driver's fingertip in the vicinity of the device's actual control panel.
- 30
19. The safety device according to claim 15 wherein the driver operable device can be alternatively operated by remote operation from a virtual control panel at

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least partially duplicating the functionality of the device's actual control panel, said icon positioning apparatus substantially continuously tracking the position of the driver's fingertip on said virtual control panel for display of said icon on said head-up display image of said virtual control panel.

5

20. The safety device according to claim 19 wherein said virtual control panel includes at least two virtual selection controls for determining the driver operable device, or components thereof, to be remotely operated therefrom.

10 21. The safety device according to claim 19 wherein said virtual control panel includes the same layout of virtual pushbuttons for controlling two or more different driver operable device and/or components of one of the driver operable devices.

15 22. The safety device according to any one of claims 19 to 21 wherein said icon positioning apparatus is constituted by a manually operated icon positioning apparatus deployed on the motor vehicle's steering wheel.

20 23. The safety device according to any one of claims 19 to 21 wherein said icon positioning apparatus is constituted by a virtual icon positioning apparatus operative by contact of the driver's fingertip on the motor vehicle's steering wheel.

25 24. The safety device according to any one of claims 15 to 23 wherein said data processing module displays a digit dialed on a mobile telephone on said head-up display image based on the position of the driver's fingertip at the instant of an audible indication indicative of the actuation of one of its pushbuttons.

30 25. The safety device according to any one of claims 15 to 24, the safety device further comprising an image acquisition device for acquisitioning an

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image of the driver's rear field of vision, and an image processing module for rendering wireframe images of objects located in said image of the driver's rear field of vision and being connected to said data processing device for projecting a head-up display image of the driver's rear field of vision including said wireframe  
5 images.

26. The safety device according to claim 25 wherein said head-up display image of the driver's rear view of vision is automatically displayed when the motor vehicle is put into reverse gear.

27. A safety device for use in a motor vehicle, the safety device comprising:

- (a) an image acquisition device for acquisitioning an image of a driver's rear field of vision;
- 5 (b) an image processing module for rendering wireframe images of objects located in said image of the driver's rear field of vision; and
- (c) a data processing device connected to a head-up display for projecting a head-up display image of the driver's rear field of vision including said wireframe images.

10

28. The safety device according to claim 27 wherein said head-up display image of the driver's rear view of vision is automatically displayed when the motor vehicle is put into reverse gear.

15

29. The safety device according to either claim 27 or 28 for use with a driver operable device deployable in a motor vehicle, and having a manually operable control panel, and a display window, the safety device further comprising icon positioning apparatus for controlling the position of an icon representative of the position of a driver's fingertip positioned for operating the driver operable device 20 on an image of the control panel and wherein said data processing device projects a head-up display image of the control panel with said icon superimposed thereon.

25

30. The safety device according to claim 29 wherein driver operation of the driver operable device is effected by manual actuation of the device's actual control panel, said head-up display image of the control panel being a substantially exact replica of the device's actual control panel, and said icon positioning apparatus substantially continuously tracking the position of the driver's fingertip relative to the device's actual control panel for display of said 30 icon on said head-up display image.

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31. The safety device according to claim 30 wherein said icon positioning apparatus includes a plurality of finger position detection sensors deployed around at least a portion of the periphery of the driver operable device.
- 5 32. The safety device according to claim 31 wherein said head-up display image is automatically displayed on detection of the driver's fingertip in the vicinity of the device's actual control panel.
- 10 33. The safety device according to claim 29 wherein the driver operable device has a data input capability for enabling its remote operation from a virtual control panel at least partially duplicating the functionality of the device's actual control panel, said icon positioning apparatus substantially continuously tracking the position of the driver's fingertip on said virtual control panel for display of said icon on said head-up display image of said virtual control panel.
- 15 34. The safety device according to claim 33 wherein said virtual control panel includes at least two virtual selection controls for determining the driver operable device, or components thereof, to be remotely operated therefrom.
- 20 35. The safety device according to claim 33 wherein said virtual control panel includes the same layout of virtual pushbuttons for controlling two or more different driver operable device and/or components of one of the driver operable devices.
- 25 36. The safety device according to any one of claims 33 to 35 wherein said icon positioning apparatus is constituted by a manually operated icon positioning apparatus deployed on the motor vehicle's steering wheel.
- 30 37. The safety device according to any one of claims 33 to 35 wherein said icon positioning apparatus is constituted by a virtual icon positioning apparatus.

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operative by contact of the driver's fingertip on the motor vehicle's steering wheel.

38. The safety device according to any one of claims 29 to 37 wherein said data processing module displays a digit dialed on a mobile telephone on said head-up display image based on the position of the driver's fingertip at the instant of an audible indication indicative of the actuation of one of its pushbuttons.  
5
39. The safety device according to any one of claims 29 to 37 wherein the driver operable device has a data output capability whereby said head-up display image also displays the same information as displayed in the device's display window pursuant to driver operation.  
10
40. The safety device according to any one of claims 27 to 39 wherein the driver operable device has a I/O data capability, and the safety device further comprises a speech recognition module connected to said data processing device for providing an output control signal thereto corresponding to a spoken command for remote operation of the driver operable device, and said head-up display image displays displays the same information as displayed in the device's display window pursuant to a spoken command.  
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20

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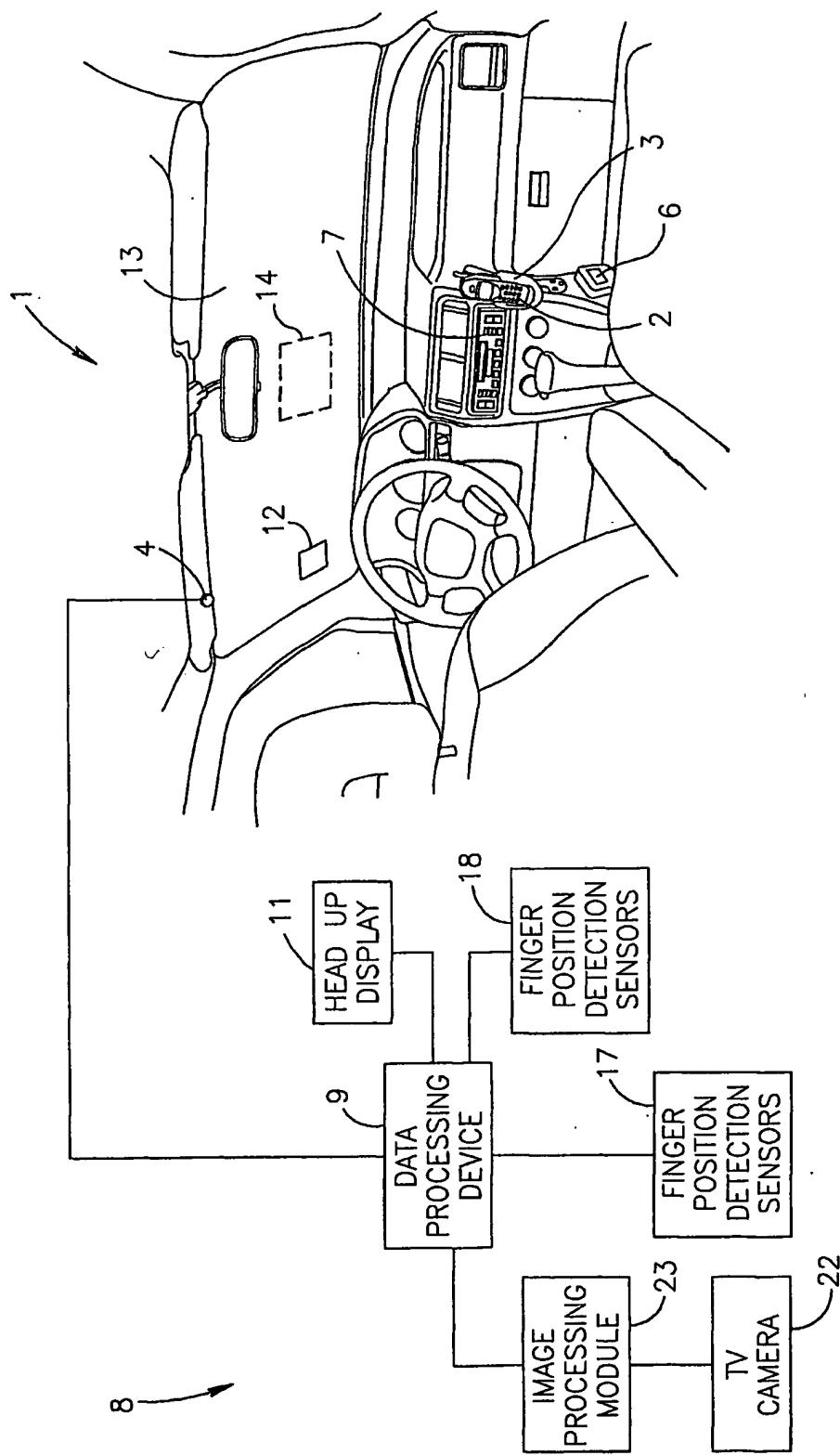


FIG. 1

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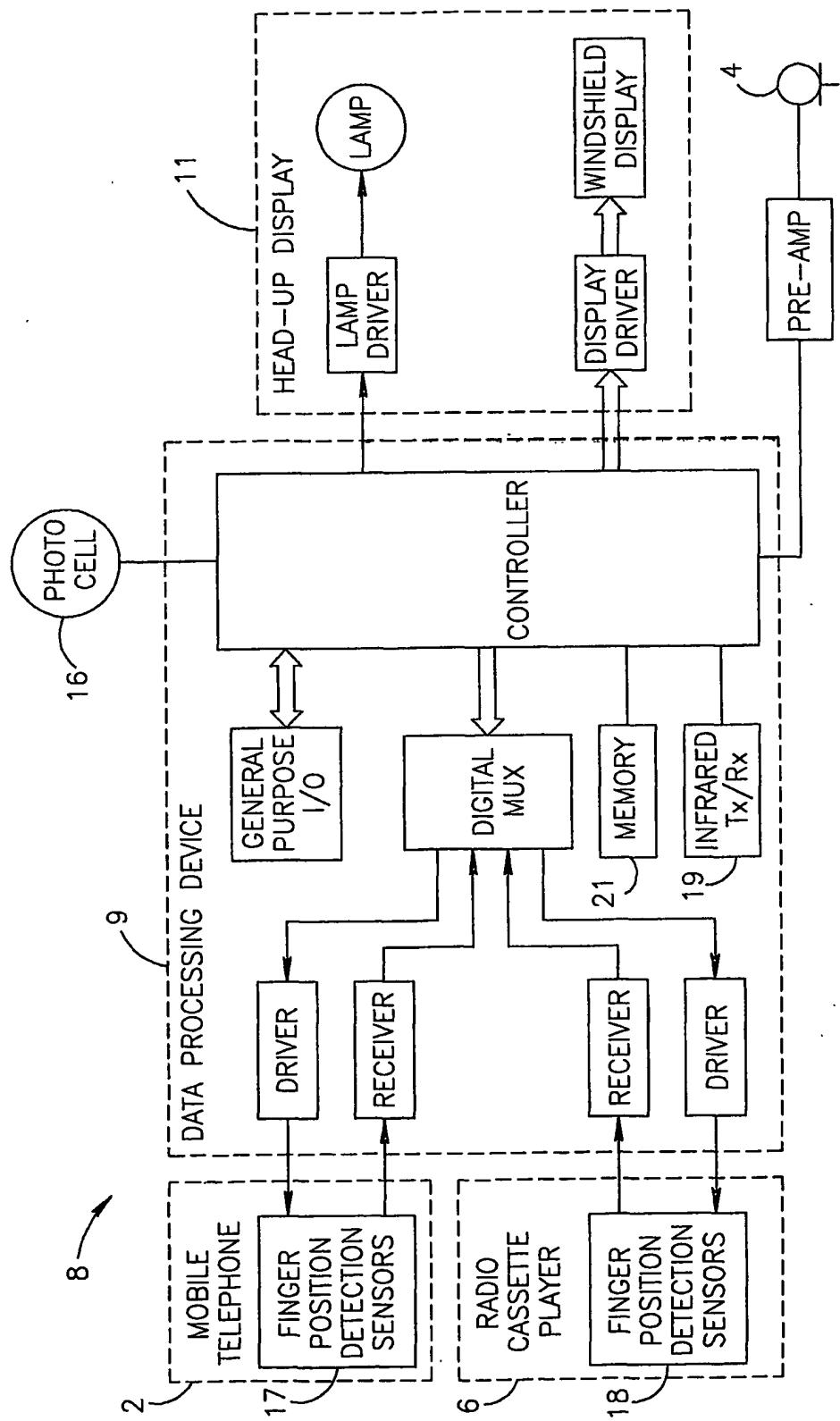


FIG.2

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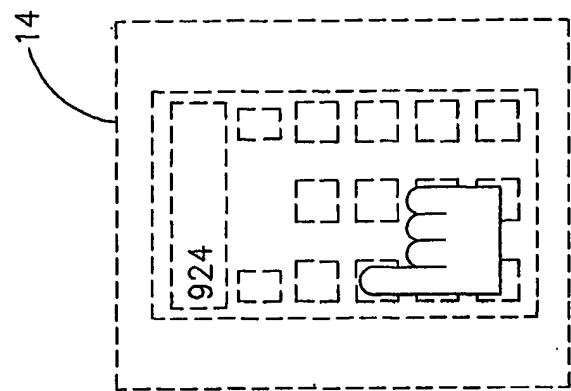


FIG. 3B

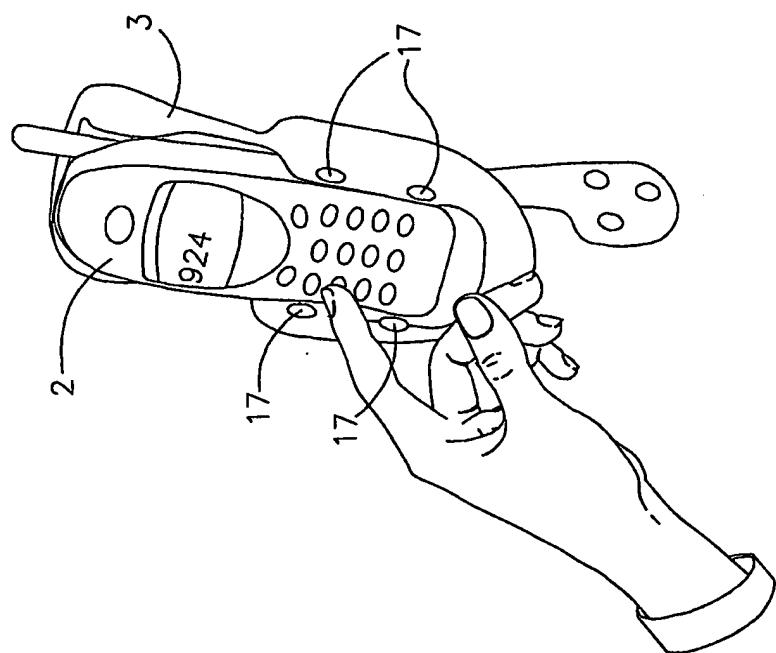


FIG. 3A

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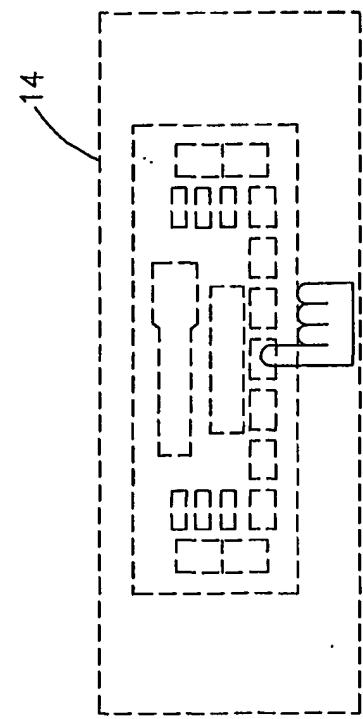


FIG. 4B

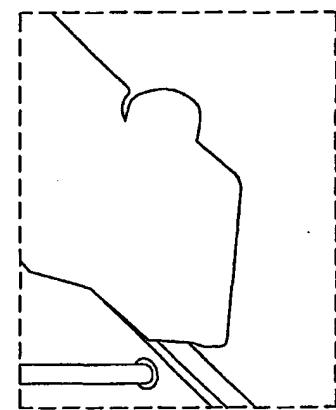


FIG. 5

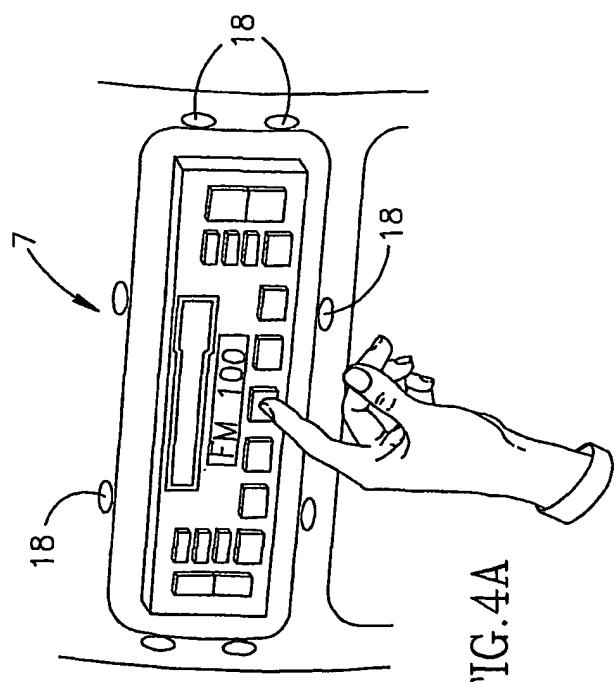


FIG. 4A

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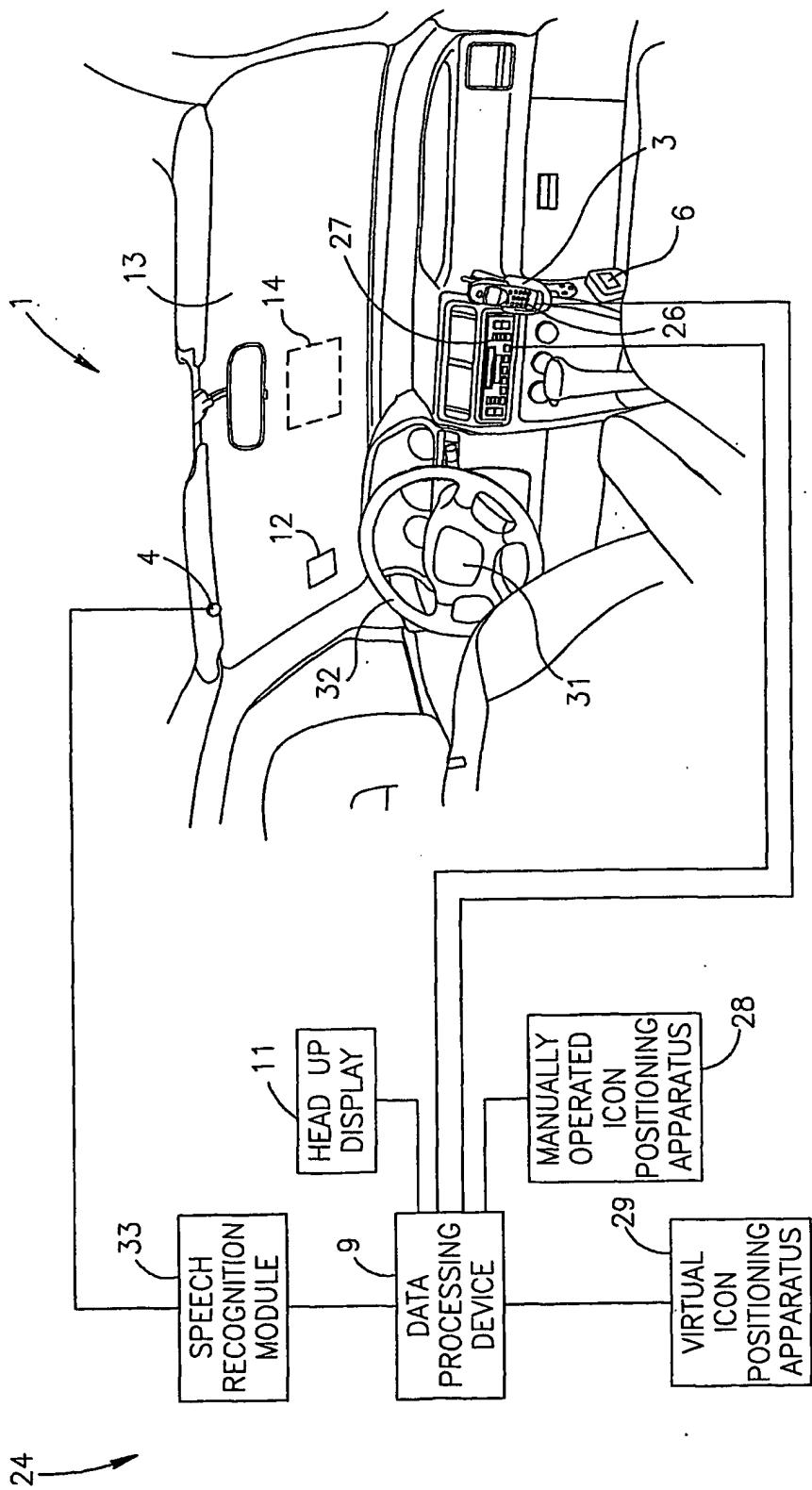


FIG. 6

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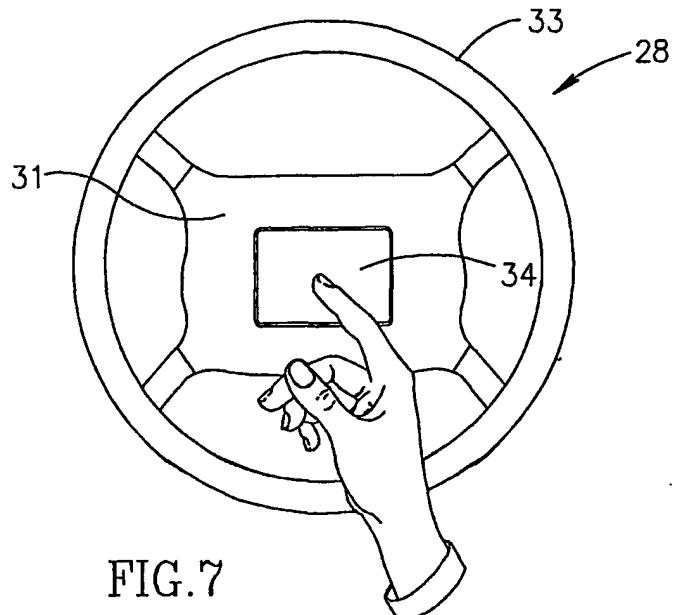


FIG. 7

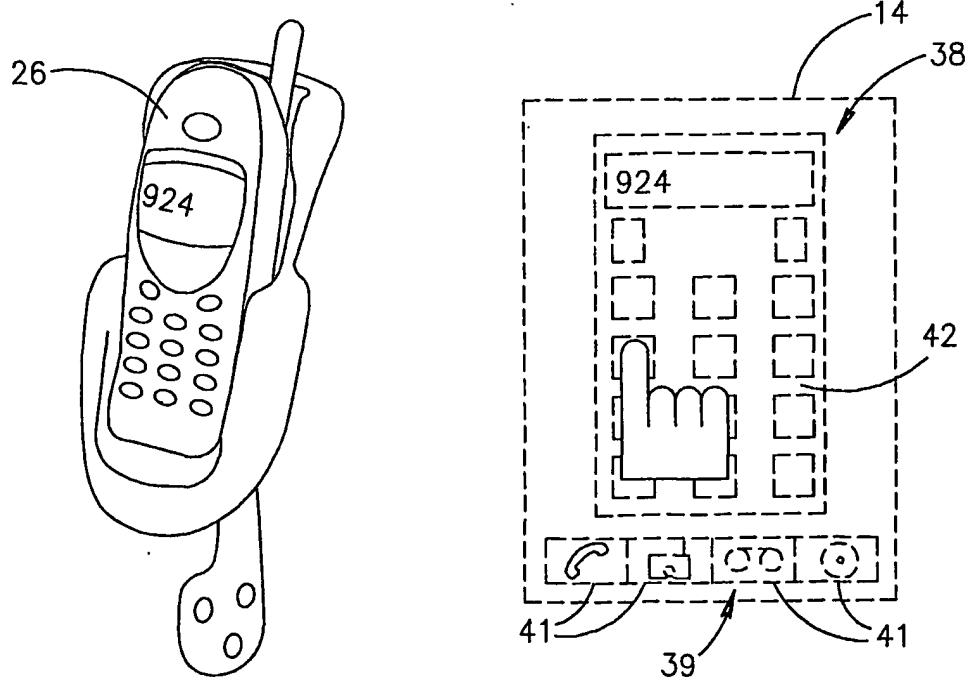


FIG. 8A

FIG. 8B

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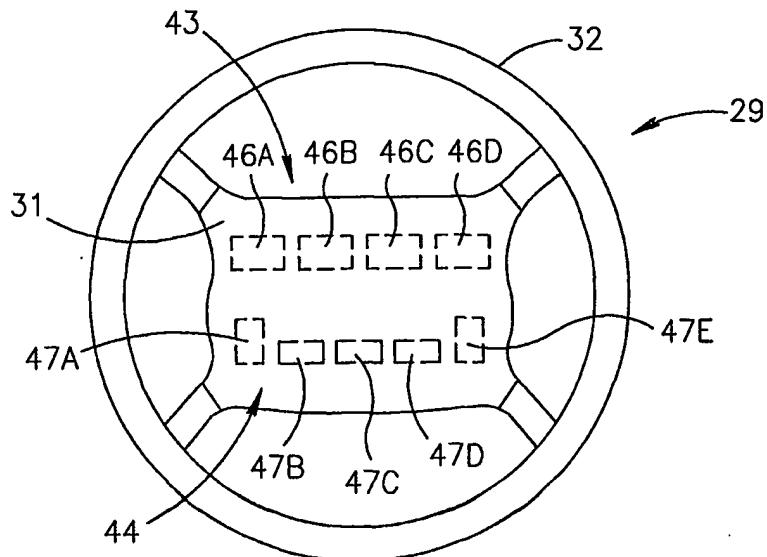


FIG.9

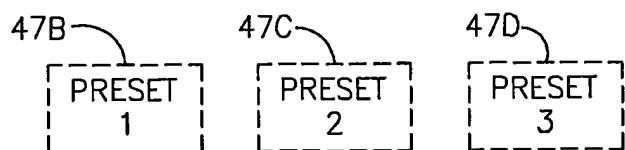


FIG.10

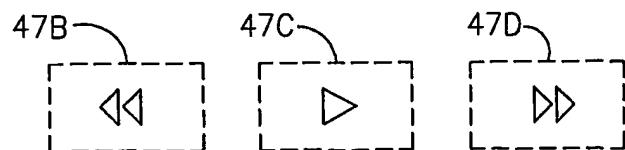


FIG.11

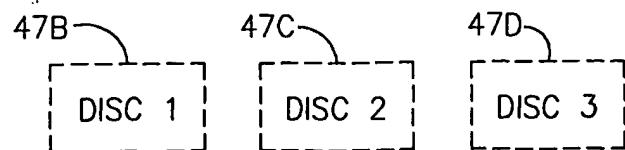


FIG.12

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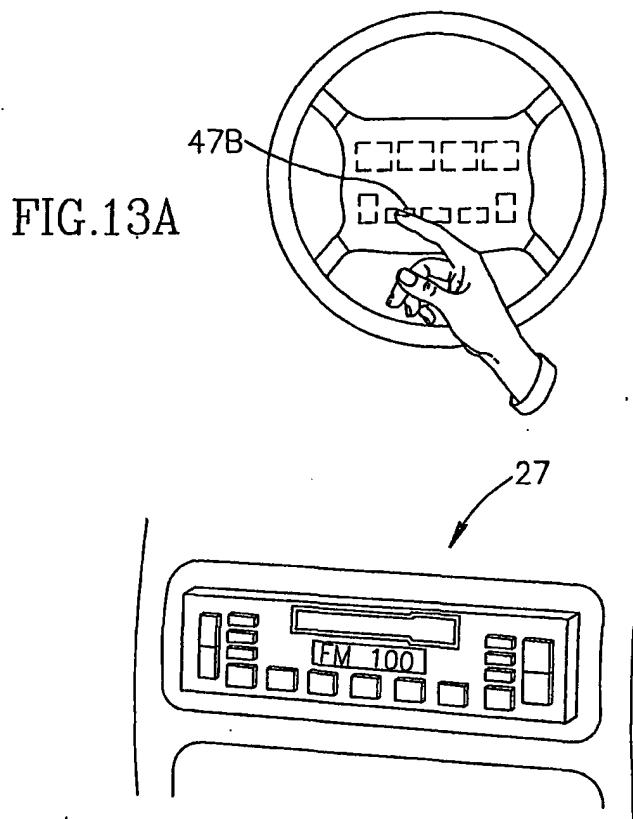


FIG.13B

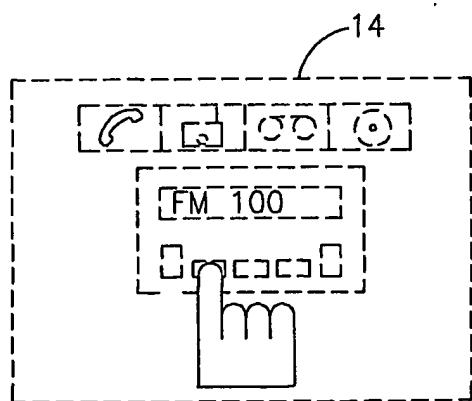


FIG.13C

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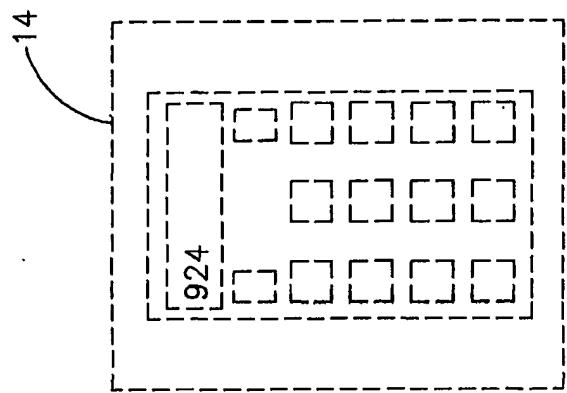


FIG.14B

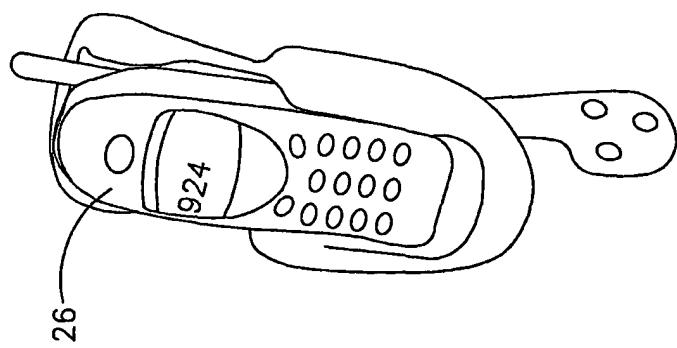


FIG.14A